

**WHAT IS CLAIMED IS:**

1. A thulium-doped fiber amplifier comprising:

a thulium-doped fiber to amplify optical signals belonging to S-band;

5 a first pumping unit configured to output an amplified spontaneous emission that represents a peak value in a predetermined wavelength range belonging to C-band to pump the thulium-doped fiber; and

a second pumping unit to output pumping light belonging to the C-band and a different wavelength band to pump the thulium-doped fiber.

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2. The thulium-doped fiber amplifier according to claim 1, wherein the first pumping unit comprises:

an erbium-doped fiber to generate an amplified spontaneous emission;

15 a second wavelength selective coupler to combine inputted optical signals and the amplified spontaneous emission;

a splitter, coupled to form a loop as a circulating path of the amplified spontaneous emission and the second wavelength selective coupler, to split and output power of the amplified spontaneous emission and the optical signals; and

20 a filter, disposed on the loop, to filter the circulating amplified spontaneous emission based on a predetermined transmission wavelength belonging to the C-band.

3. The thulium-doped fiber amplifier according to claim 1, wherein the first pumping unit includes a pump laser diode outputting light at a predetermined wavelength.

4. The thulium-doped fiber amplifier according to claim 1, wherein the second  
5 pumping unit includes a pump laser diode outputting light at a predetermined wavelength.

5. The thulium-doped fiber amplifier according to claim 4, wherein the predetermined wavelength for the first and second pumping units is 0.98  $\mu\text{m}$ .

10 6. A thulium-doped fiber amplifier comprising:  
a thulium-doped fiber to amplify optical signals in an S-band;  
a first pumping unit to generate an amplified spontaneous emission to pump the thulium-doped fiber, and disposed to form a loop in a circulating path of the amplified spontaneous emission, wherein the amplified spontaneous emission represents a peak value  
15 in a preset wavelength range belonging to C-band, is generated by filtering the circulating amplified spontaneous emission; and  
a second pumping unit to output pumping light to pump the thulium-doped fiber.

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7. A thulium-doped fiber amplifier according to claim 3, wherein the first pumping unit comprises:

an erbium-doped fiber to generate an amplified spontaneous emission;

a second wavelength selective coupler, disposed on one side of the erbium-doped fiber, to combine the inputted optical signals and amplified spontaneous emission;

a splitter, disposed on the other side of the erbium-doped fiber, to form a loop of the amplified spontaneous emission and the second wavelength selective coupler, to split and output power of the amplified spontaneous emission and the optical signals; and

a filter, disposed on the loop, to filter and output the circulating amplified spontaneous emission based on a predetermined transmission wavelength belonging to the C-band.

8. A thulium-doped fiber amplifier according to claim 4, wherein the first pumping unit further comprises:

a first pumping light source to output pumping light to pump the erbium-doped fiber; and

a first wavelength selective coupler to combine the pumping light with the power of the erbium-doped fiber.

9. A thulium-doped fiber amplifier according to claim 4, wherein the first pumping unit further comprises a first isolator, disposed on the loop, to transmit the amplified spontaneous emission in one direction.

10. A thulium-doped fiber amplifier according to claim 3, wherein the second pumping unit comprises:

a second pumping light source to output pumping light belonging to the C-band and a different wavelength band to pump the thulium-doped fiber; and

5 a third wavelength selective coupler to combine the pumping light with the power of the thulium-doped fiber.

11. A thulium-doped fiber amplifier according to claim 1, further comprises a second isolator, disposed between the first and second pumping units, to block light  
10 inputted from the side of the thulium-doped fiber, wherein the first pumping unit is disposed in the front of the thulium-doped fiber and performs front-pumping of the thulium-doped fiber.

12. A thulium-doped fiber amplifier according to claim 3, wherein the first  
15 pumping unit is disposed in the rear of the thulium-doped fiber and performs rear-pumping of the thulium-doped fiber.